

## VOLTAGE TRIPLER

### ■ GENERAL DESCRIPTION

The NJU7670 is a voltage tripler incorporated CR oscillator, voltage converter, reference voltage circuit and voltage regulator.

It can generate triple or double negative voltage of an operating voltage ranging from -2.6V to -6V.

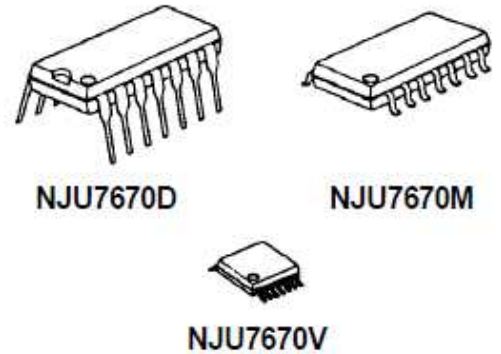
The application circuit of tripler requires three capacitors, and doubler requires only two capacitors.

Furthermore, any kind of output voltage is available by the internal voltage regulator.

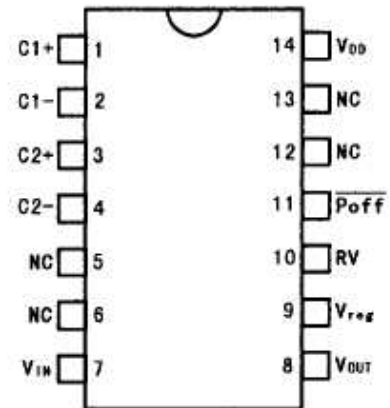
### ■ FEATURES

- Triple / Double Voltage Output
- Operating Voltage      — -2.6V to -6.0V
- High-efficiency Voltage Conversion Rate  
                                  — 95% ( $I_{OUT} = 5mA$ )
- High Output Current     — MAX 20mA ( $V_{IN} = -5V$ )
- CR Oscillator ON-Chip
- Output - OFF Function By External Signal  
                                  — ON / OFF of  $V_{reg}$
- C-MOS Technology
- Package Outline           DIP/DMP/SSOP 14

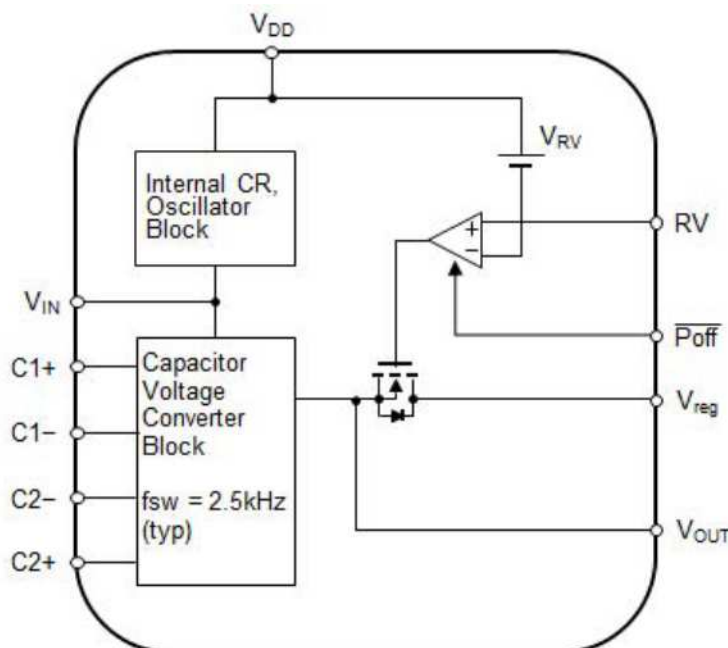
### ■ PACKAGE OUTLINE



### ■ PIN CONFIGURATION



### ■ BLOCK DIAGRAM



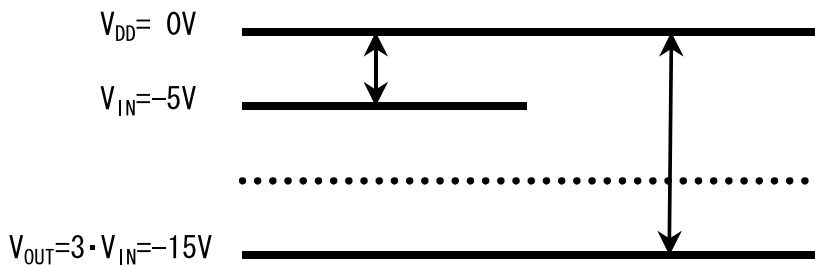
## ■ TERMINAL DESCRIPTION

No.	SYMBOL	FUNCTION
1	C1+	Charge Pump Capacitor 1(+) Connecting Terminal
2	C1-	Charge Pump Capacitor 1(-) Connecting Terminal
3	C2+	Charge Pump Capacitor 2(+) Connecting Terminal
4	C2-	Charge Pump Capacitor 2(-) Connecting Terminal
5	NC	Non Connection
6	NC	Non Connection
7	V <sub>IN</sub>	Power Supply Terminal (-)
8	V <sub>OUT</sub>	Voltage Output Terminal
9	V <sub>reg</sub>	Voltage Regulator Output Terminal
10	RV	Voltage Regulator Adjustment Terminal
11	$\overline{\text{Poff}}$	V <sub>reg</sub> Output ON/OFF Control Terminal
12	NC	Non Connection
13	NC	Non Connection
14	V <sub>DD</sub>	Power Supply Terminal (+)

## ■ FUNCTIONAL DESCRIPTION

### (1) Voltage Converter

The voltage converter generates double or triple voltage against V<sub>IN</sub>.



### (2) Voltage Reference Circuit

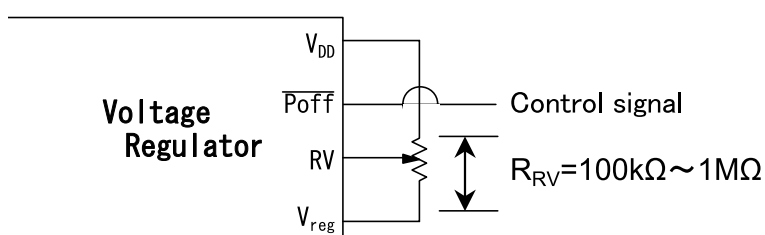
The voltage reference circuit is generating the reference voltage for a voltage regulator.

### (3) Voltage Regulator

The voltage regulator output stabilized voltage which regulated by using the external resistor against double or triple voltage of the input voltage.

#### (3-1) Output-OFF Function

As this circuit incorporated output-off function, the voltage regulator output (ON/OFF) is performed by the signal come from system.



- ON/OFF Control for V<sub>reg</sub> Terminal

$\overline{\text{Poff}}$ Level	V <sub>reg</sub> Output
"H" (Connect to V <sub>DD</sub> )	ON
"L" (Connect to V <sub>IN</sub> )	OFF

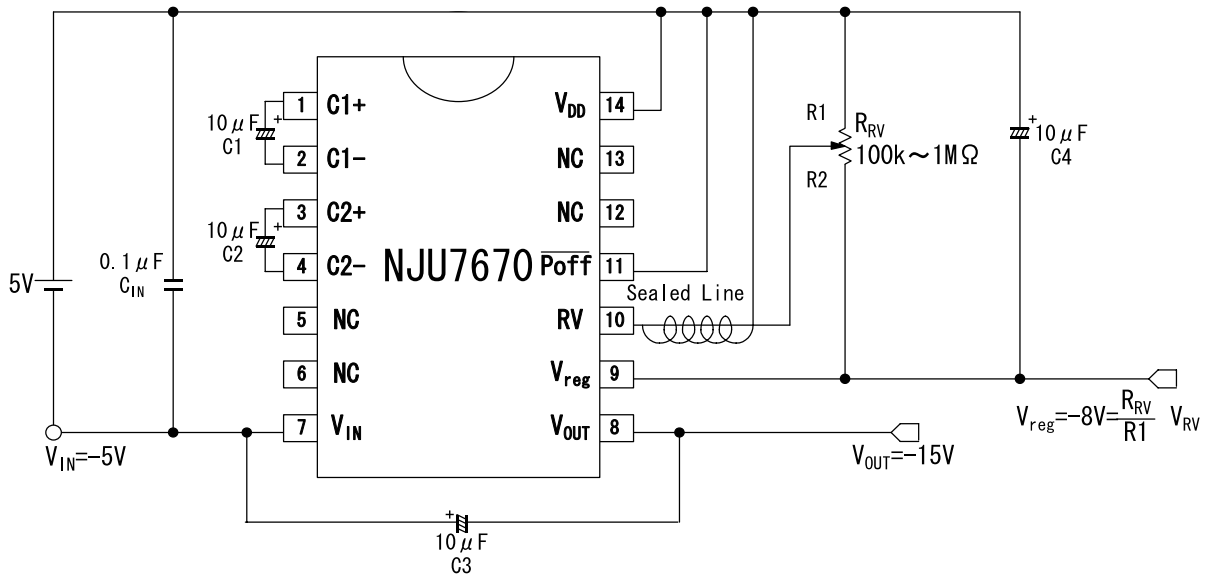
### (3-2) Example of the Voltage Regulation

The voltage regulator has a output terminal which can be adjusted the output voltage to any kind of voltage by resistance  $R_{RV}$ .

As the RV terminal input impedance is high. Therefore special care against noise is required.

(Use a sealed line or others noise-proof method)

### Tripler Operation + Voltage Regulator Operation



The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.

The decoupling capacitor ( $C_{IN}$ ) connect as close as possible to the IC.

# NJU7670

## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V <sub>IN</sub>	V <sub>DD</sub> - V <sub>DD</sub>   ≤ 20	V
Input Voltage	V <sub>I1</sub>	V <sub>IN</sub> -0.5 to +0.5 Note1)	V
	V <sub>I2</sub>	V <sub>OUT</sub> -0.5 to +0.5 Note2)	
Output Voltage	V <sub>OUT</sub>	-20.0	V
Power Dissipation	P <sub>D</sub>	DIP	700
		DMP	300
		SSOP	300
Operating Temperature Range	Topr	-20 to +85	°C
Storage Temperature	Tstg	-40 to +125	°C

Note1): Apply to Poff terminal

Note2): Apply to RV terminal

## ■ ELECTRICAL CHARACTERISTICS

(V<sub>DD</sub>=0V, V<sub>IN</sub>=-5V, C<sub>IN</sub>=0.1μF, Ta=25°C) Note3)

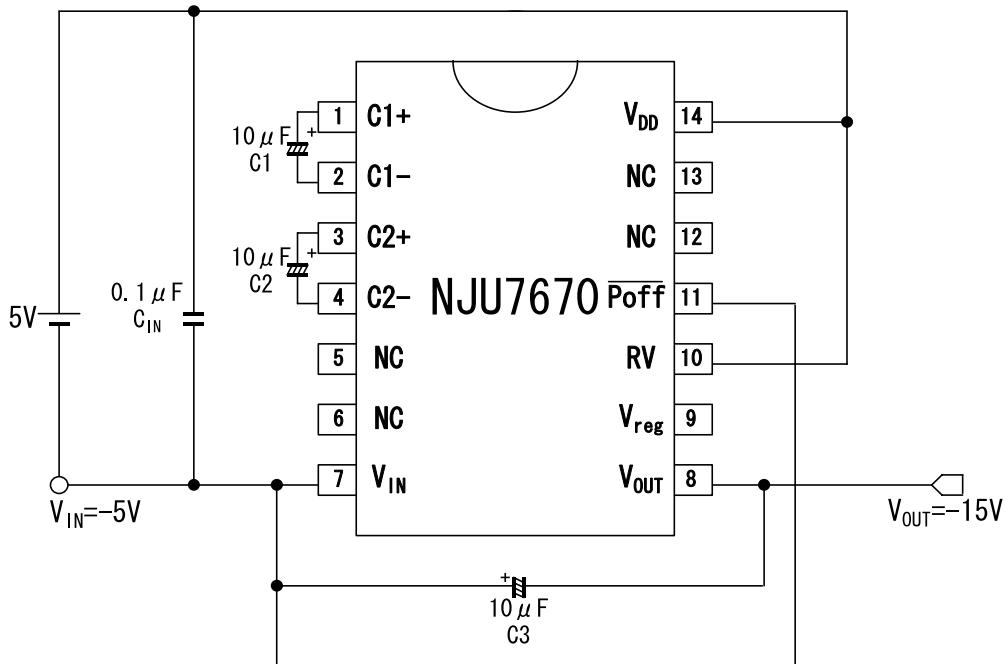
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V <sub>IN</sub>		-6.0	-	-2.6	V
Output Voltage	V <sub>OUT</sub>		-18.0	-	-	V
	V <sub>reg</sub>	RL = ∞, R <sub>RV</sub> = 1MΩ, V <sub>OUT</sub> = -18V	-18.0	-	-2.6	
Regulator Operating Voltage	V <sub>(OUT)</sub>		-18.0	-	-8.0	V
Current Consumption 1	I <sub>DD1</sub>	Poff="H" note4) RL = ∞, R <sub>RV</sub> = 1MΩ, V <sub>reg</sub> = -2.6V	-	75	120	μA
Current Consumption 2	I <sub>DD2</sub>	Poff="L" note4) RL = ∞, R <sub>RV</sub> = 1MΩ	-	60	100	μA
Output Impedance	R <sub>OUT</sub>	I <sub>OUT</sub> = 20mA, C1 = C2 = C3 = 10μA	-	150	200	Ω
Power Conversion Rate	P <sub>eff</sub>	I <sub>OUT</sub> = 5mA, C1 = C2 = C3 = 10μA	90	95	-	%
Line Regulation	$\frac{\Delta V_{reg}}{\Delta V_{OUT} \cdot V_{reg}}$	-18V < V <sub>OUT</sub> < -8V V <sub>reg</sub> = -8V, RL = ∞	-	0.2	-	%/V
	$\frac{\Delta V_{reg}}{\Delta I_{reg}}$	V <sub>OUT</sub> = -15V, V <sub>reg</sub> = -8V 0 < I <sub>reg</sub> < 20mA	-	5.0	-	Ω
Output Saturation Resistance	R <sub>SAT</sub>	R <sub>SAT</sub> = Δ(V <sub>reg</sub> - V <sub>OUT</sub> ) / ΔI <sub>reg</sub> 0 < I <sub>reg</sub> < 20mA, RV = V <sub>DD</sub>	-	8.0	-	Ω
Reference Voltage	V <sub>RV</sub>		-2.3	-1.5	-1.0	V
Input Current 1	I <sub>IN1</sub>	RV Terminal	-	-	1.0	μA
Input Current 2	I <sub>IN2</sub>	Poff Terminal	-	-	2.0	μA
Switching Frequency	f <sub>sw</sub>		-	2.5	-	kHz

Note3): To achieve the best operation, select the input capacitor (C<sub>IN</sub>) with enough margin according to the stability of supply voltage.

Note4): Excluding input current on R<sub>RV</sub>

## ■ APPLICATION CIRCUITS (1)

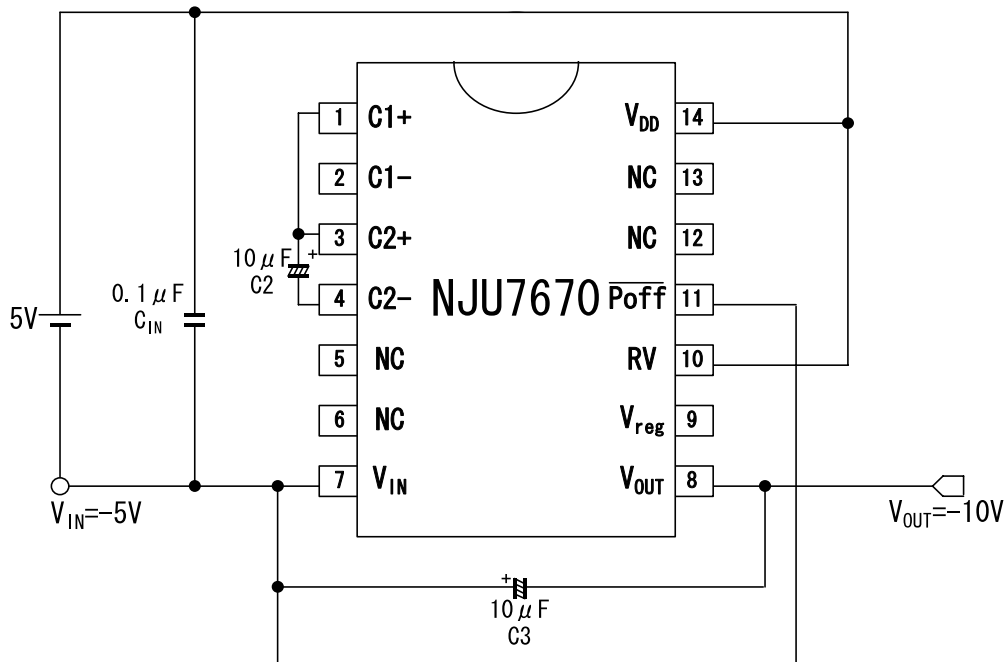
### (1-1) Tripler Operation



The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.

The decoupling capacitor ( $C_{IN}$ ) connect as close as possible to the IC.

### (1-2) Doubler Operation

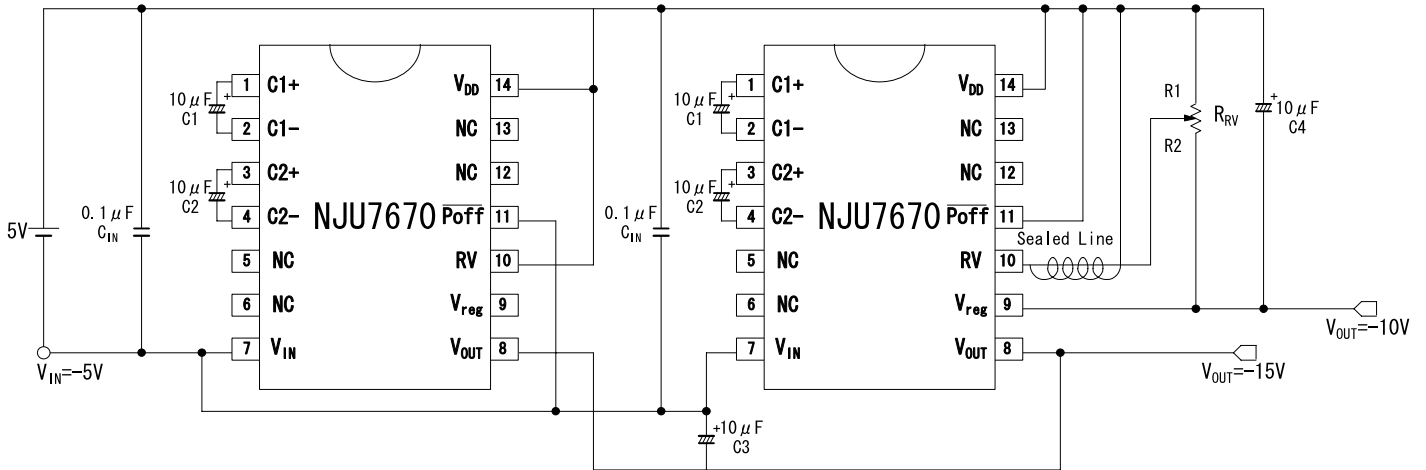


The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.

The decoupling capacitor ( $C_{IN}$ ) connect as close as possible to the IC.

■ APPLICATION CIRCUITS (2)

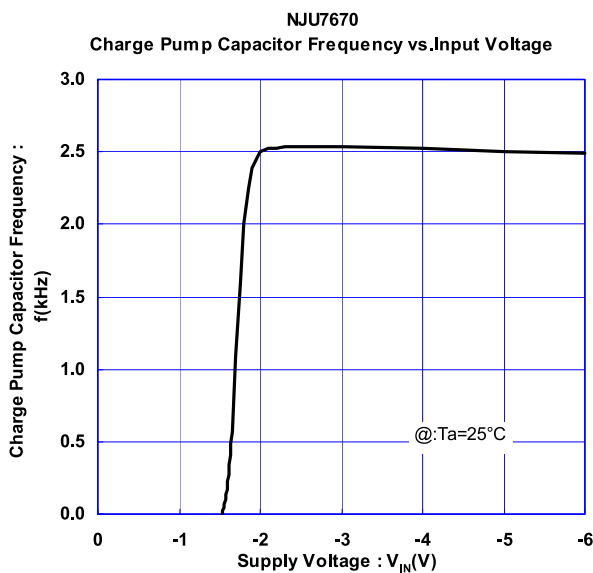
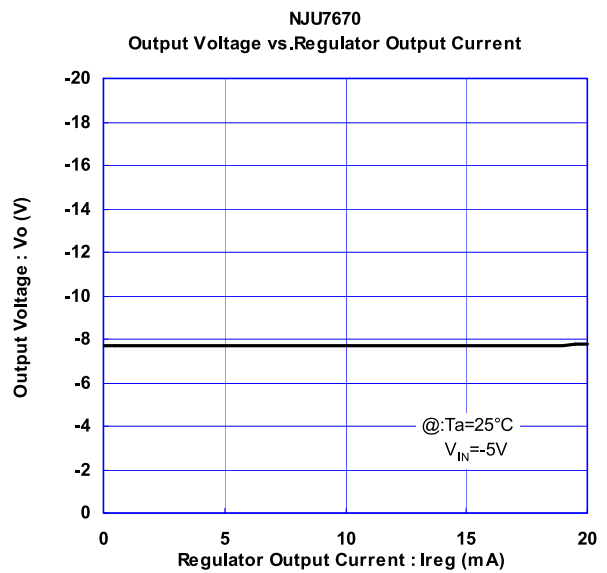
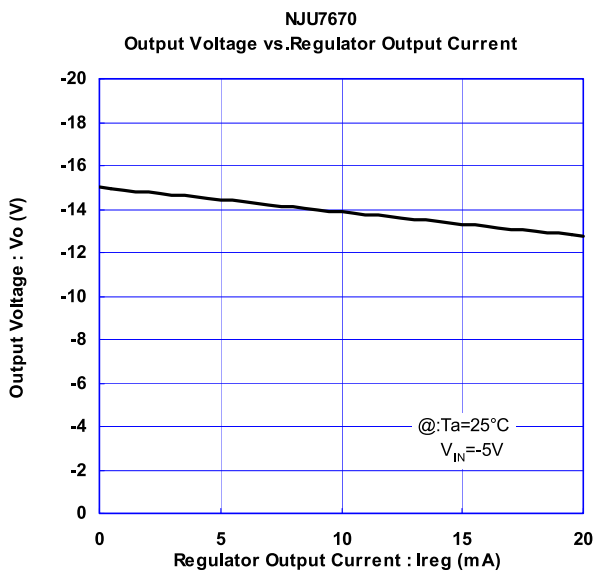
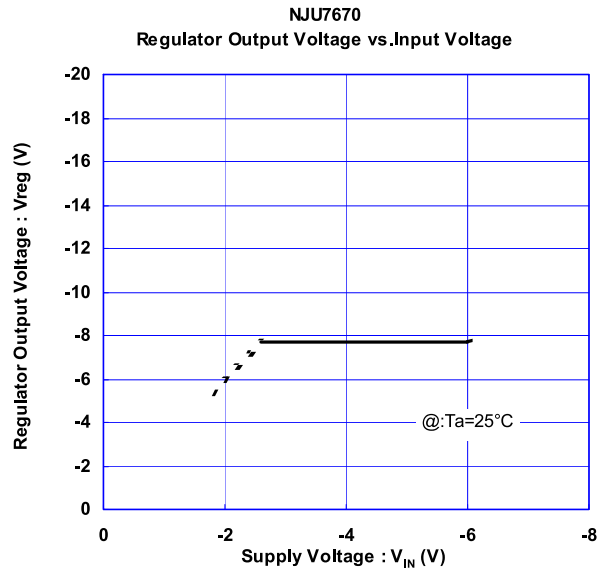
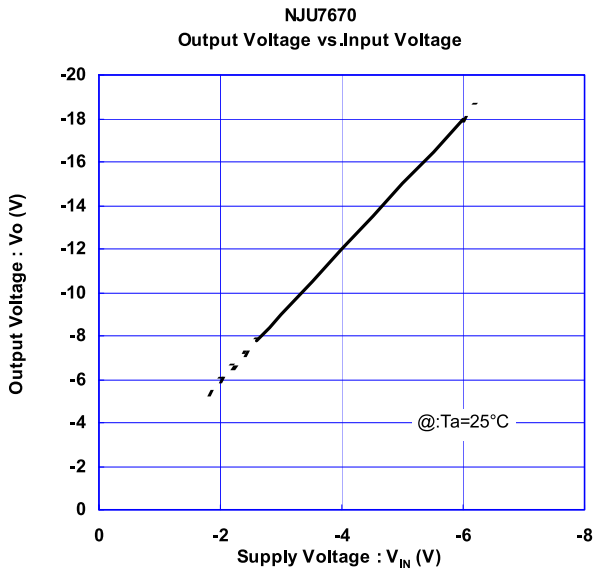
(2) Parallel Connection



- \* The output impedance  $R_{OUT}$  can be reduced by parallel connection.
- \*  $C_3$  is a stabilizing capacitor output for stabilized voltage.
- \* In the parallel connection, one stabilizing capacitor using is better way.
- \* The IC may have a possibility not to operate properly with unstable supply voltage due to large transient current when the capacitor is charged or discharged.

The decoupling capacitor ( $C_{IN}$ ) connect as close as possible to the IC.

## ■ TYPICAL CHARACTERISTICS (CIRCUITS CONDITION : Tripler Operation + Voltage Regulator Operation)



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